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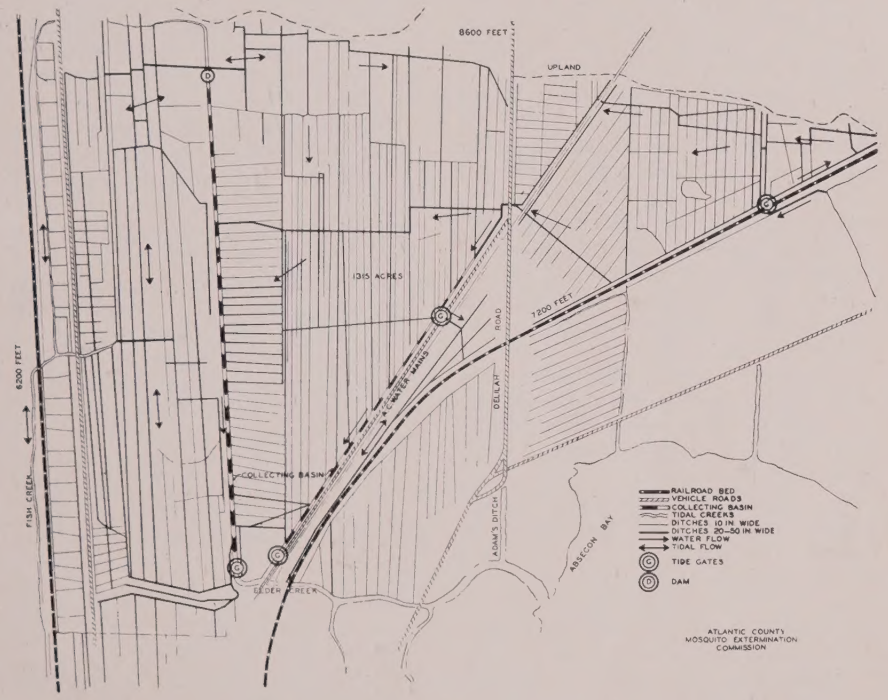
CIRCULATION OF TIDE WATER SAVES SALT MARSH AND STOPS MOSQUITO BREEDING

FRED A. REILEY
Supt., Atlantic County (N.J.) Mosquito Extermination Commission

On a field trip some time ago much interest was expressed by members of the American Mosquito Control Association in the special problem and its solution which are described below.

1. Fish Creek (left side of map) emptied into the nearby bay at about "6200."
2. Collins Ditch (on the map as "Collecting Basin") emptied through a small tide gate into Elder Creek.



In the area as shown on the map, landmarks will be referred to as follows:

1. On the left, Reading Railroad Embankment.
2. Top, Upland.
3. Right, Pennsylvania Railroad Embankment.
4. Bottom, Elder Creek and Absecon Bay.

As we found it in 1914, there was heavy breeding of Aedes sollicitans over the entire area of 1315 acres. Available outlets were:

3. Adams Ditch then extended to the upland, and on the extreme right to two 36 inch pipes under the Pennsylvania Railroad embankment.

With the exception of the two 36 inch pipes, there appeared to be adequate outlets for open salt marsh drainage.

There were no fresh water streams emptying into this marsh area; but the normal rainfall plus run-off from the adjoining upland were to be reckoned with.

Many old "Line Ditches" were found filled with mud, and we installed new

ditches. Later the old ditches had to be cleaned and footage added to the new work. This gave the very high average per acre of 1,218 unit feet.

In spite of this work we still had mosquito breeding in spots near the upland. Also after storm tides, water sometimes remained over the area for as much as three weeks. Yearly ditch cleaning was necessary.

Changes began to take place. Fish Creek was cut off at its outlet and a ten-foot ditch installed connecting this creek to tide water. Several thousand feet were added to reach the new outlet.

Then Delilah Road was constructed on the site of Adams Ditch. This was the real blow, as this ditch carried all of the water from the middle and to the right of this area.

Then the construction of a new roadbed by the Pennsylvania Railroad cut off the two 36 inch pipes for a while.

The area to the right of Delilah Road then received practically no tide water and salt grasses began to die.

C. C. C. then came along and we prevailed upon them to construct and install some tide gates. First under Delilah Road and then in both large and small "Collecting Basins."

We tried bringing tide water through tide gate on one side of the area to the right of Delilah Road and removing it from the opposite side. The trip, about 7,500 feet in and a like distance out, was much too long and we continued to find breeding. This time *Aedes vexans.*

By this time the railroad bed was completed and the 36 inch pipes opened. Salt water came in and the next step was to get rid of it.

The tide gates were removed from under Delilah Road and one gate was installed at the 36 inch pipes. This gate opened in and forced the salt water to the ditch next to the upland and through this and connection ditches to outlet. Circulation was the result; and to date we have not found mosquito breeding.

During the time this area received no salt water about 30 per cent of salt water grasses died. These grasses are now coming back.

Circulation seemed to be the answer to our problem and plans were made for the area between Delilah Road and the Reading Railroad bed.

Fish Creek continued to be a good source for tide water, but most of the water went out through the large "Collection Basin."

This collection basin has about 30 square feet of tide-gated outlets. Not enough to carry off the water brought in by Fish Creek.

We cut off all connections between Fish Creek and the "Collection Basin" and carried the tide water to a large ditch next to the upland and most of the water returned through the regular ditching system to the "Collection Basin" and out through the gates into Elder Creek.

Some of this water returned through Fish Creek as normal ebb tide.

The small "Collection Basin," parallel to the "Pipe Lines," has one gate of 3.66 square feet opening from side and three gates of 10.98 square feet at its outlet into Elder Creek.

You will note that about 75 per cent of the outgoing water flows into Elder Creek and then to Absecon Bay.

There has been no change in salt grasses to the left of Delilah Road. The area to the right has gone through two seasons of low rainfall and the salt grasses appear to be holding their own. A wet season may change this condition and force us to lead more salt water into the ditches through 36 inch pipes.

AN INSECT LIGHT TRAP FOR USE WITH AUTO VEHICLES IN THE FIELD

By ELWOOD A. SEAMAN, Ph.M. 2/c, U.S.N.R.

A light trap usable in the field where light power of 110 volts is not available can be valuable for certain insect studies, especially of mosquitoes. Having such a need, the writer designed a trap which can be attached to and operated from the battery of an auto vehicle. A trap of this kind can be taken to the breeding grounds of certain species of mosquitoes to determine their approximate abundance, to determine flight habits and movements; and can be used for census studies of new areas, obtaining species data by using a minimum of time when covering extensive areas. This field trap is operated where light attraction methods can be employed only by means of a storage battery. For those species which show negative phototropism it has been successfully demonstrated that, by chance, adults have been caught in the trap when the light bulb was detached, leaving but the drawing action of the fan to capture them.

This trap operates similarly to others commonly used by entomologists; however has some changes in principle of operation. The motor and fan of this design lie in a position below the killing jar, and by a down draft of air all insects attracted to the bright light are captured. It operates well for two hours at one time without overtaxing the storage battery to which it is clamped. By placing the lighted trap on the hood of the auto the beams of the light are cast in all directions from the vehicle, assuring the best possible attraction for insects in the immediate vicinity.

Construction

This light trap can be constructed easily and with a minimum of cost. Most parts can be hand made, some salvaged. The searchlight reflector, 5⅝ inches in diameter, is obtained from a four-cell dry battery searchlight unit. It aids greatly in spreading a brighter light to attract the insects. Into this reflector is soldered an auto light bulb socket, and into the socket is placed a single beam 32 candlepower 6-8 volt auto headlight bulb. Care should be taken to solder the socket in a position whereby the light bulb protrudes one and one-half inches below the reflector to permit the brilliant glow of the filament to shine free into the area about the vehicle. This feature of the trap proved to increase the efficiency of the "catching power," mainly because of the glaring light. Metal straps hold the reflector above the vertical cone of the lower parts of the trap. To prohibit large insects, Lepidopterans especially, from entering the trap a piece of hardware cloth, ½ by ½ inch squares, is placed on top of the cone through which the insects pass. This cone is made of a fine mesh bronze wire screen. At the end of the cone is soldered the lid of the killing jar. The hole in this lid has a diameter of three-fourths inch. The cylinder housing this apparatus can be fitted to the base of the trap either by a flanged seam, or merely by a tight-fitting overlap onto the base, through which the killing jar is reached for examination. A defrosting fan-motor unit, commonly used for automobile windshields, is attached to the base and rests directly below the killing jar. The fan blades are twisted in reverse so that it will draw air, in place of blowing. This motor operates on six volts and creates sufficient speed required to draw most insects into the jar. Electrical wiring runs from the motor to battery clamps, as well as to the top of

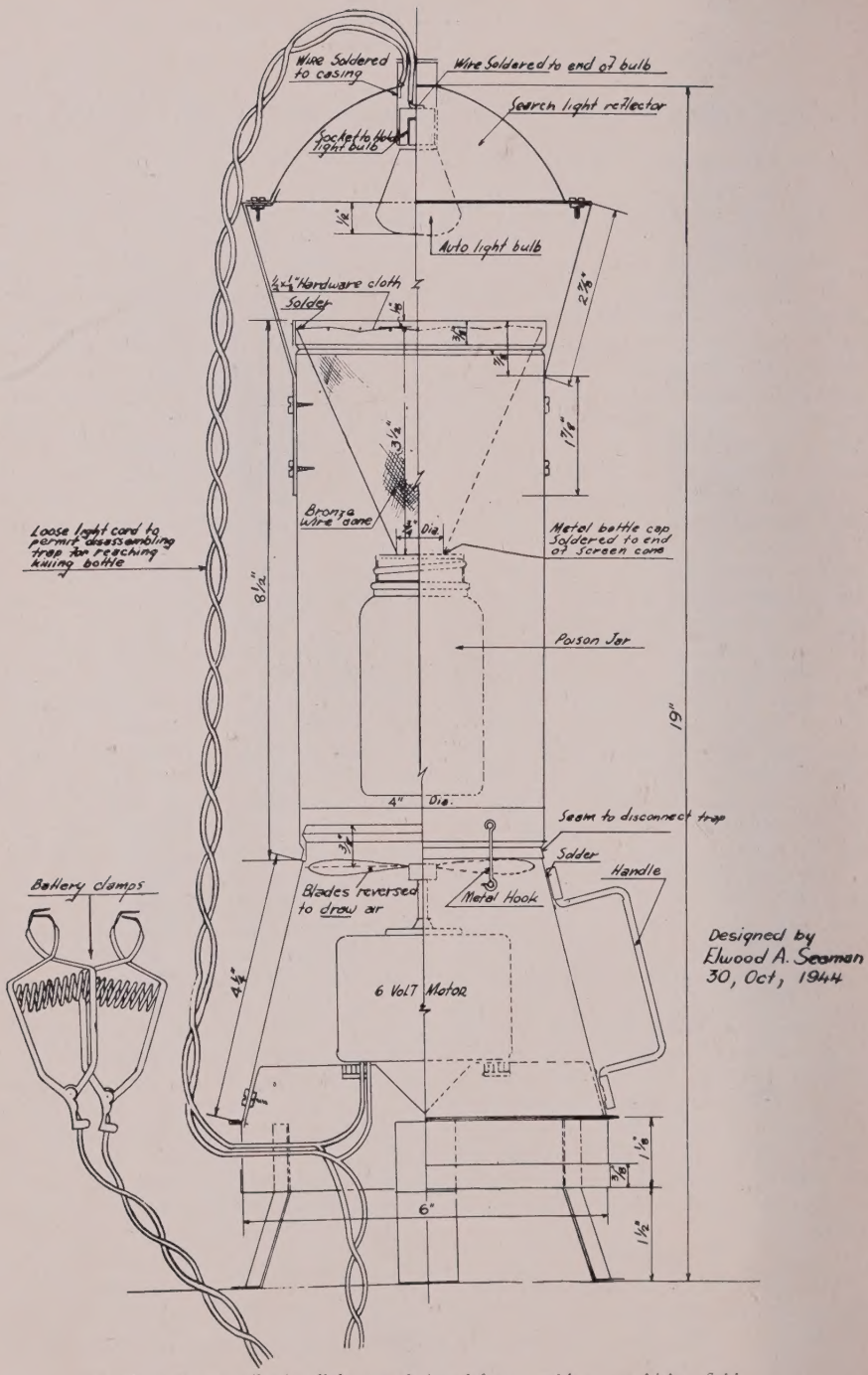


Fig. 1. Insect collection light trap designed for use with auto vehicles afield.

the reflector where its separate wires are soldered to the socket and the plate which connects with the end of the light bulb.

This trap has been used afield successfully by the writer. On one occasion 120 *Culex erythrothorax* adult mosquitoes were caught in a twenty-minute period. Four genera of mosquitoes have been captured by it in both the desert and sea coast sections of Southern California.

C. S. Richards, a co-worker, was very helpful in the original designing of this trap, and for his aid the writer expresses appreciation.

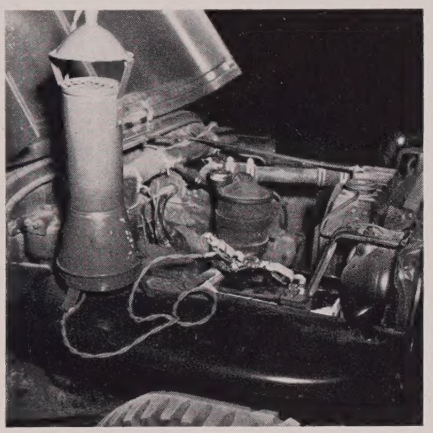


Fig. 2. Light trap in operation. Is clamped to battery and usually sets on top of the hood where light beams can spread over the surrounding ground.

OUTDOOR REARING OF *ANOPHELES QUADRIMACULATUS* SAY

PAUL M. EIDE

U. S. D. A., Agr. Res. Adm., Bureau of Entomology and Plant Quarantine [1, 2]

The outdoor colony of *Anopheles quadrimaculatus* Say. described in this paper was started in the spring of 1943, in conjunction with the indoor colony at the Orlando, Fla., laboratory of the Bureau of Entomology and Plant Quarantine, to augment the supply of larvae and adults for experimental purposes, and also to furnish a reserve supply in case the colony at Orlando should be destroyed.

The colony is located in a creek arising from Rock Spring in Kelly Park, 6 miles north of Apopka in Orange County, Fla., and 20 miles from the main laboratory. This spring flows from a cave beneath a large limestone cliff, at the rate of about 26,000 gallons per minute. The stream it forms is narrow and swift near the source, but widens out to about 150 feet a hundred yards below the cliff, where it is shallow enough for a person to wade with hip boots.

The water is clear and does not have the sulfur odor characteristic of many spring waters in the vicinity. It contains small amounts of dissolved solids, the most important being calcium carbonate at the rate of 46 p.p.m. The pH is 7.6.

The most important feature of the spring, in relation to the mosquito colony, is its constant temperature of 76° F. The temperature of this water apparently never varies, although air temperatures as low as 40° will lower the water temperature 1 degree at the rearing boxes. However, winter temperatures as low as this are not general in Florida, and mosquitoes can be reared the year round, although production is somewhat curtailed during the cooler months.

The stream is filled with aquatic plants. The most important of these are eelgrass (*Vallisneria americana* Michx.), waterlettuce (*Pistia stratiotes* L.), pickerelweed (*Pontederia cordata* L.), and coontail (*Ceratophyllum demersum* L.). Numerous algae are also present. With the protection of these plants natural breeding of anophelines goes on continually. Both *Anopheles quadrimaculatus* and *A. crucians* Wied. are found, the proportion of the former being greatest near the spring and gradually diminishing farther down the stream.

Description of the Rearing Boxes.—The colony was confined in a number of oblong wooden boxes suspended in the water (fig. 1). Each box was made of one-foot cypress lumber, the inside measurements being 1 by 5 feet. The bottom was covered with 30-mesh copper screen to permit free exchange of water, and the top with a removable cover of window screen. It was found necessary to use heavily galvanized nails to fasten the copper screen to the bottom; otherwise an electrolysis was set up between the copper and the iron, which destroyed the iron in a few weeks. The frame of the cover was made an inch or two larger than the box, so that the weight of the frame would press the screen down tightly enough to exclude spiders. Each box was suspended 6 or 8 inches in the water by means of four stakes driven into the sand of the stream bed. The boxes were nailed lightly to

[1] This work was conducted under a transfer of funds, recommended by the Committee on Medical Research, from the Office of Scientific Research and Development to the Bureau of Entomology and Plant Quarantine.

[2] The writer wishes to acknowledge the assistance of C. C. Deonier, under whose supervision this work was done; of Edward Nottingham for advice and help at various times; and of M. A. Mitchell for his faithful assistance in tending the colony.

Fig. 1. General view of boxes for outdoor rearing of *Anopheles quadrimaculatus*.

the stakes for easy removal, since the buoyancy of the boxes made little support necessary. In the first boxes used, the screen was covered with a coat of shellac to protect it from corrosion, and also to make the openings smaller so that none of the first-instar larvae could pass through. Later experience showed that few of these larvae would dive far enough to be carried out through the screen, and the shellac was omitted to provide better circulation of water.

During December, 1943, when the air temperature was 42° F., the temperature of the water near the boxes was 75°. At the same time the temperature of the water in two old boxes with clogged screens was 71° to 73°, while in the new boxes with open screens it was the same as the water outside. This slight lowering of temperature lengthened the larval period and thereby decreased the number of pupae produced.

Growth of algae and the accumulation of food on the screens in the old boxes soon rendered them water proof and shut off all circulation of water. The resulting stagnation killed hundreds of fourth-instar larvae, especially during cold weather when the period required for development was longer.

The original colony was contained in 11 boxes, but as the period of larval development lengthened in cooler weather 9 more boxes were needed. Later, when the colony had doubled in size, a total of 40 rearing boxes were used.

Technique.—Larvae 3 days old, hatched in pans in the laboratory, were transported to Rock Springs in wide-mouth gallon jugs. The jolting 20-mile trip apparently had no deleterious effect on the larvae.

The box to be filled was removed from its stakes and scrubbed thoroughly with a brush, the screen bottom being given special attention. It was then replaced, and the surface of the water inside was covered with a layer of the ribbonlike leaves of eelgrass. The larvae were then poured into

the box; if care was used, they rarely sank below the layer of grass.

Twice a day the larvae were fed brewer's yeast and finely ground dog food by shaking it over the surface from a spice can. For the first 3 days yeast only was used, because the dog food sometimes caused a scum to form which engulfed the small larvae. Part of the food sank, of course, but some of it was supported by the eelgrass within reach of the larvae (fig. 2). The larvae were observed to feed below the surface if the food was close enough so that they could reach it without losing contact with the surface. This observation has since been verified in the laboratory. Thus, except during cold weather, two feedings each day, plus whatever natural food was introduced with the eelgrass, proved to be enough to bring the larvae to the pupal stage in almost the same length of time as that required in the laboratory.

The boxes were not covered except for the window screen. The driving rains during the summer months doubtless sank much of the dog food, but evidently did not wash it from the eelgrass, since the production of pupae during these months was usually very good.

Pupae were removed from the boxes daily. To accomplish this it was found easiest to sink the eelgrass with a piece of hardware cloth cut the same size as the box, and to dip both the larvae and the pupae into a large enamel pan. The pupae were separated from the larvae by means of a medicine dropper. The eelgrass was then allowed to float to the surface and the larvae were returned to the box. The pupae were taken to the laboratory, where they were allowed to emerge in cages. The pupae were transported in the same jugs that were used for the small larvae. Again, the jolting ride seemed to have very little injurious effect, even when there were as many as 4,000 pupae in a single gallon jug.

At first a large dipper was used to remove the larvae and the pupae. Later a

Fig. 2. Fourth-instar larvae of *Anopheles quadrimaculatus* feeding on dog food supported by eelgrass.

scoop made by gluing plastic window screen to a wire frame was found to do the work more rapidly, and although the treatment would seem rough handling for larvae, no injurious effects were noticed over a long period of time. The screen scoop also had the advantage of leaving the smaller larvae in the box where they did not hinder the picking of pupae.

During the summer months the larval period was about 2 weeks. Larvae 3 days old, when placed in the boxes, began pupating after 6 or 7 days, and pupation was usually over by the 11th day. This was almost the same as the larval period in the laboratory. During the winter months the first pupae appeared 9 to 11 days after introduction and the pupation was finished after about 18 to 22 days. If any larvae were left when a box was due to be started, they were placed in a box where pupation had just begun. During June 237,667 pupae were produced, or an average of 7,922 per day.

Since there was an abundance of eggs, it was thought that doubling the number of small larvae introduced might be an economical measure even if the increase in the number of pupae was only 10 per cent. Between November 21 and December 31, 1943, 47 boxes were started, 12 with only 3,000 first instars, 27 with 6,000, and 8 with 9,000. The average numbers of larvae and pupae produced in the three groups were 1,260, 2,194 and 2,115, and the maximum numbers from any one box in the respective groups were 2,011, 3,400, and 2,830. The larvae that had not pupated in 20 days were retained in pans floating in the boxes.

The total production of pupae in 1944 is shown in table 1. Twenty boxes were in production from January to May and 30 from May to December. The pupal mortality shown approximates closely that of the laboratory-reared pupae.

It seems that about 3,000 pupae is all that can be expected from a 5-square-foot box, regardless of the number of larvae at the start. When 9,000 larvae were used they did very well until the third instar. At this stage some of them got a head start and consumed most of the food. As a result most of the larvae starved to death before they reached the fourth instar. Not only did the larger number fail to give any increase in the number of pupae, but they made picking of pupae difficult, the pupae were noticeably smaller, and the larval period was usually lengthened. Heavy mortality in the first instar was evident in the boxes started with only 3,000 larvae. The difficulty seemed to be in the feeding, as a slight excess caused a scum to form that was fatal to many of the small larvae.

Table 1.—Effect of the Introduction of Various Numbers of Larvae Into Rearing Boxes on the Production of Pupae During 1944

Month	Larvae Introduced	Pupae Collected	Average Pupae Per Day	Mortality of Pupae
	Number	*Number*	*Number*	*Per Cent*
	20 BOXES IN PRODUCTION			
January	203,000	94,255	3,040	18
February	207,000	111,385	3,840	10
March	276,000	113,550	3,660	8
April	330,000	126,030	4,210	9
	30 BOXES IN PRODUCTION			
May	468,000	206,350	6,655	6
June	492,000	208,170	6,939	5
July	474,000	209,580	6,760	8
August	540,000	193,735	6,250	6
September	588,000	161,610	5,387	6
October	660,000	205,500	6,630	4
November	666,000	167,060	5,568	8
December	564,000	92,935	2,998	7

THE OCCURRENCE OF *PSOROPHORA MEXICANA* (*BELLARDI*) IN THE UNITED STATES

CHARLES R. JOYCE, Assistant Sanitarian (R)
U. S. Public Health Service

The first known record of the occurrence of *Psorophora mexicana* (Bell.) in the United States was obtained by the writer on June 6, 1944, near Brownsville, Texas, when a single female was taken while biting. On June 10, 1944, four additional biting females were collected at the same site. *P. cyanescens* and *Aedes thelcter* were very abundant at the time. Both of these collections were made about 4 o'clock in the afternoon in a small wooded area near an irrigation canal alongside of which were numerous temporary shaded pools occasioned by heavy rains which had occurred about one week previously. Although extensive search was made, no larvae could be found. The place of collection is located approximately two miles from the City of Brownsville, four miles from the Port of Brownsville and two miles from the International Airport. There is a possibility, therefore, that this species could have been introduced by either ship or aircraft. If established in this locality it apparently is very rare.

The identity of the first specimen obtained was confirmed by Dr. Alan Stone of the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, and has been deposited in the U. S. National Museum. The other specimens are in the collection of the author. *P. mexicana* is quite small in size when compared with other species of *Psorophora* of the subgenus *Janthinosoma* occurring in the United States and is characterized by having the last hind tarsal segment white. Little is known concerning the biology and distribution of this tropical mosquito species. Dyar (Mosquitoes of the Americas, 1928) describes the female and gives its distribution as "Mexico." Martini (Los Mosquitos de Mexico, 1935) names two localities in the State of Oaxaca, Mexico, in which it occurs. The male and larva are unknown.

ANALYSIS OF A TIDAL DITCH AND ITS CROSSINGS

LEON DALENCOUR, Civil and Sanitary Engineer
Port-au-Prince, Haiti

The observation here reported was made in Aquin, Haiti, a town located 85 miles southwest of Port-au-Prince, the capital of Haiti.

In the low and flat ground of surrounding salt marshes earthen tidal ditches are used extensively.

Pipes are installed in the bottoms of ditches and covered with earth-fill to allow crossing.

These pipes are laid at varying depths, and no particular care has been taken concerning their level with reference to the outlet pipe "A" as shown in Fig. 1.

During an extreme low-tide period, when the highest water level reaches the line W.S. in Fig. 1, which coincides with the *bottom* level of pipe "A," ditch breeding occured.

Silting took place between pipes A and C, and so on up ditch from every pipe that was higher than the ditch above it. See Fig. 1.

Breeding took place in pools thus formed by the high points in the ditch.

During an extreme high-tide period the water surface may reach the line W.S. and above as shown in Fig. 3.

The silting which may occur rapidly in a rainy season can become as important as indicated by the black area of Fig. 3.

The ditch ceases to function as a result of the complete obstruction of the pipe, producing a prolific breeding basin above this point.

Pipe B is almost completely filled, causing the lowering of the salinity of the water between pipe B and the pass-over at D.

Maintenance expenses are high in such a ditch when the enormous volume of mud has to be removed by means of pails.

The following conclusion may be drawn:

1. The bottom line of all pipes laid in a tidal ditch should be level with the outlet.
2. A pipe of which the bottom level is higher than the bottom of the ditch above, or lower than the outlet, is a failure from the standpoint of eradicating mosquito breeding places.

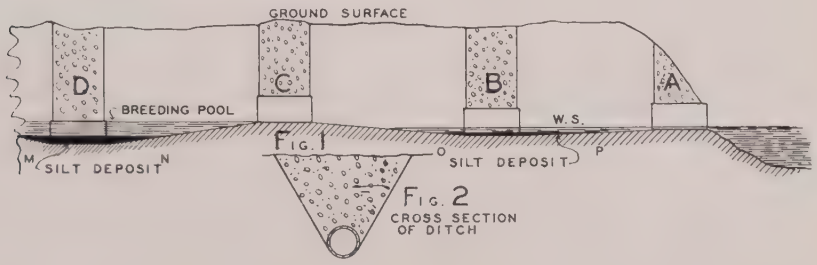


FIG. 1

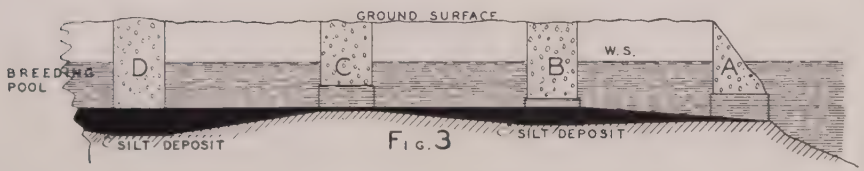


FIG. 3

A NEW STATE RECORD OF *MEGARHINUS RUTILUS* COQUILLETT IN SOUTH CAROLINA

STANLEY J. CARPENTER[1] AND DALE W. JENKINS[2]
Fourth Service Command Medical Laboratory
Fort McPherson, Georgia

Megarhinus rutilus Coquillett is a rare treehole-breeding species previously recorded for Florida and Georgia. A new state record of this species was obtained from Myrtle Beach, South Carolina, which extends its known range considerably farther north.

The specimens were collected from a treehole at Myrtle Beach AAF, South Carolina, in October, 1944, by Sgt. Allen Hall. Fifteen fourth instar larvae were sent to the Fourth Service Command Medical Laboratory, where they were reared. Of the ten males which emerged, three were *M. rutilus,* determined by the white scales present on the second segment and basal part of the third segment of the fore tarsi. These male specimens were compared with paratype specimens from Georgia and Florida in the National Museum. A series of *Megarhinus septentrionalis* Dyar and Knab was obtained from the same treehole.

[1]Major, Sanitary Corps, Army of the United States.

[2]2nd Lieutenant, Sanitary Corps, Army of the United States.

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ECOLOGICAL OBSERVATIONS AND RECENT RECORDS ON MOSQUITOES OF SAN DIEGO AND IMPERIAL COUNTIES, CALIFORNIA

ELWOOD A. SEAMAN

Public interest in mosquitoes has steadily grown in recent years due to the increased number of military personnel returning from foreign fields with mosquito-borne diseases. Communities are becoming aware of the need for information on the mosquitoes of their respective areas, and since no material has been published recently on the mosquitoes of San Diego and Imperial Counties it is felt this paper will be of particular interest at this time for these localities. While this paper does not deal with medical phases of mosquito-borne diseases, it contains pertinent data on the distribution and abundance of the various species which will have value for further studies of mosquito-borne diseases in Southern California.

For example, many disease vectors are known to be present in the area. Hammon and Reeves (1) showed *Culex tarsalis,* a common species in San Diego and Imperial Counties, could serve as a reservoir for the virus of St. Louis and western equine encephalitis, and is able to transmit the infection. They have shown that experimentally in the laboratory the following species found in the above mentioned counties are capable of transmitting St. Louis encephalitis, *Culex quinquefasciatus, Culex pipiens, Aedes vexans, Culiseta incidens,* and *Culiseta inornata.* Hammon and Reeves demonstrated that western equine encephalomyelitis can be transmitted experimentally also by *Aedes vexans, Aedes dorsalis, Culiseta incidens, Culiseta inornata,* and *Culex tarsalis.* These are species considered in this paper.

The established vector of malaria in Southern California is *Anopheles maculipennis freeborni* (2). Laboratory infection of Filariasis, *Wuchereria bancrofti,* was accomplished in San Diego with two species of mosquitoes. These were *Culex erythrothorax* and *Culex quinquefasciatus* (3).

The major part of these observations was confined to an area approximately within a thirty-mile radius of San Diego City; however, occasional collecting trips were taken to representative breeding habitats over the entire county. Several field trips were made into Imperial County, and data from these collections are included.

San Diego County is an area of 4,200 square miles, and is unusual because of the great extremes of climatic conditions within its borders. One can leave the mild coastal climate and in one day travel by automobile through altitudes as high as 6,300 feet, thence descend to desert areas which are almost below sea level. These three features, a coastal strip, a mountainous region, and a desert, present a wide variety of habitats in which mosquitoes may breed. The annual average temperature in San Diego City is a maximum of 71.9° F. and a minimum of 55.1° F. The average total yearly rainfall is 10 inches. Cuyamaca Peak is the highest elevation above sea level, having an altitude of 6,515 feet. The average yearly snowfall for Cuyamaca State Park is 38.2 inches. The annual average temperatures in the park are: maximum of 48.7° F., a minimum of 41.0° F. Weather records for Carrizo Desert are similar to the town of Imperial, yearly average rainfall 3.65 inches, yearly average maximum temperature 88.3° F., and minimum of (= 55.0°) F. The area in the immediate vicinity of San Diego City receives most of its pre-

cipitation in the months of January, February and March. Temporary pools formed from rainwater often remain until June or July; therefore breeding of mosquitoes is heavy at such times. The most permanent stream of the county is the San Luis Rey River. The San Diego River and the Sweetwater River flow about ten months yearly, usually being intermittent in the months of July and August.

At the present time many canyons draining into the coastal strip of the county which usually were dry in the summer months have fast flowing streams throughout the year. This condition is the result of the many military reservations which empty treated sewage and waste water into them. Such water creates habitats for several species of mosquitoes.

Twenty-three species are considered in this report. One species, *Uranotaenia anhydor* Dyar, because of its rareness, is given particular attention. Most of the determinations were checked by W. C. Reeves, Ph.D., George Williams Hooper Foundation, who also kindly read and criticised this paper; some by Alan Stone, Ph.D., National Museum. Their initials are placed with the species they identified as it is described. For their help the writer is very thankful. Appreciation is here expressed to Lt. Commander G. R. Underwood, MC, USNR, through whom this work was made possible while the writer was assigned to a Navy Epidemiology Team.

Anopheles maculipennis freeborni Aitken

HABITAT AND DISTRIBUTION: This species has been collected over the entire county, from the coldest stream or lake to hot springs in Carrizo Desert (Caliente Hot Springs). It favors clean, clear water, with or without algal mats; it, however, is generally collected from the grassy edges of shallow water. Often it has been taken from the following: lakes and reservoirs, permanent ponds and pools, borrow pits with either clear banks or vegetated banks, hoof prints, small depressions containing seepage water, springs, streams, and high tide pools.

LARVAL ASSOCIATES: *Anopheles pseudopunctipennis fraciscanus, Uranotaenia anyhydor, Culiseta inornata, Culex thriambus, and Culex tarsalis.*

ABUNDANCE: Common. Sometimes abundant. Most common between September and June.

SPECIFIC DATA: Has been found breeding in high tide pools with a concentration of salt 2660 ppm. (expressed in total chlorides).

Anopheles maculipennis occidentalis Dyar & Knab (Det. W.C.R.)

HABITAT AND DISTRIBUTION: Adults of this species have been collected from Sorrento Canyon and in the gorge area at the headwaters of San Luis Rey River. Female specimens from the former were examined by Reeves. These two habitats are quite different, the former being a marshy area in the mouth of a canyon at sea level; the latter a clear mountainous stream of rapids and waterfalls. Breeding here occurred in the feather edges of comparatively still water at the borders of the stream.

LARVAL ASSOCIATES: Not known here.

ABUNDANCE: Adults were occasionally collected with *Anopheles maculipennis freeborni* in the two locations from which it has been found; however, they may be common in other places in the county as yet not discovered.

SPECIFIC DATA: The writer believes, as far as literature has been available to him, this to be the southern-most West Coast record for *Anopheles maculipennis occidentalis.*(5)

Anopheles punctipennis Say

HABITAT AND DISTRIBUTION: This mosquito was reported from Camp Pendelton, Oceanside, California, by J. M. Hutzel, Ensign, H-V(S), USNR, on September 25, 1943. The writer has searched for it numerous times throughout San Diego County, but has failed to find adults or larvae.

ABUNDANCE: Rare.

Anopheles pseudopunctipennis franciscanus Theobald (Det. W.C.R.)

HABITAT AND DISTRIBUTION: This species may be found in this county throughout the year in most bodies of comparatively clean, still water, be it a pond, pool, lake or stream. It prefers algal mats, yet will occur in unvegetated water. Like *Anopheles maculipennis freeborni,* it has been found in cold water in the mountains as well as warm water in the desert. Many times it is directly associated with *A. m. freeborni;* but will also at times be found breeding alone.

LARVAL ASSOCIATES: *Anophcles maculipennis freeborni, Culex tarsalis, Culex thriambus* and *Culiseta inornata.*

ABUNDANCE: Common to abundant. The most common anopheline, found throughout the entire county.

SPECIFIC DATA: On several occasions *Anopheles pseudopunctipennis* has been collected from high tide pools, and in one particular instance bred in a saline pool of 8900 ppm concentration of total chlorides. This was at Ream Air Field, near the Mexican border south of San Diego. Associated with this species was *Culex tarsalis.* Saline, high tide pools of less concentration located at the mouth of Sorrento Canyon also contained *Anopheles pseudopunctipennis.*

Culex apicalis Adams
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: This species is found in densely vegetated pools or ponds in the warmer months; it is frequently found in open sunlit pools having much aquatic vegetation during the cooler months. It is most common in the fall. *Culex apicalis* prefers clean water, and is often collected from springs or the small pools formed by them.
LARVAL ASSOCIATES: *Culex thriambus, Culex restuans, Culex tarsalis, Culiseta maccrackenae, Culex erythrothorax,* and *Anopheles maculipennis freeborni.* Often it is found breeding alone.
ABUNDANCE: Uncommon.

Culex erythrothorax Dyar
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: Wherever marshy areas exist, mainly stream, bottomland marshes with slow flowing pools running through tule and grassy beds, this species breeds heavily. It may be taken in isolated pools; however, the marsh suits it best. It will tolerate mild sewage contamination.
LARVAL ASSOCIATES: *Culex thriambus, Culex restuans, Culex tarsalis* and sometimes *Anopheles maculipennis freeborni.*
ABUNDANCE: Abundant in marshes, rare elsewhere. Occasional in winter season, breeds well all summer.
SPECIFIC DATA: Is attracted to light traps readily. Bites viciously in bright sunlight, as well as at dark.

Culex pipiens Linnaeus
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: This species is commonly collected from street drains, artificial containers, and in the many pools or puddles of water frequently found about human habitations. During the hot summer months breeding is most common in street drains filled with water from excessive lawn and garden irrigation. It may be taken from foul water at times.
LARVAL ASSOCIATES: It is often found with *Culex quinquefasciatus,* with which it is said to interbreed on the West Coast. *Culex tarsalis* and *Culex stigmatosoma* may be found with it in untreated sewage outlet pools in canyons below some residential districts of outlying areas from San Diego City.
ABUNDANCE: Abundant in warmer months, occasionally found during the cooler seasons.

Culex quinquefasciatus Say
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: Occurs around human habitations, in artificial containers, sewers and drains, and is occasionally associated with *Culex pipiens.*
LARVAL ASSOCIATES: *Culex stigmatosoma* and *Culex pipiens.*
ABUNDANCE: Common. Abundant at times.

Culex restuans Theobald
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: This species is not common, but when found is often associated with *Culex thriambus.* It has been collected from small pools and shallow depressions, such as seepage water in hoof prints. It is occasionally found in hoof prints in marshes used for cattle grazing.
LARVAL ASSOCIATES: *Culex thriambus* and *Culiseta inornata.*
ABUNDANCE: Uncommon.

Culex stigmatosoma Dyar
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: This common stagnant or foul water breeder is found at sewage plants, in street drains, in polluted water from farms, especially dairies, and occasionally in clean water adjacent to a polluted pool where this species is breeding.
LARVAL ASSOCIATES: *Culex tarsalis* and sometimes *Culex pipiens* or *Culex quinquefasciatus.*
ABUNDANCE Common to abundant.

Culex tarsalis Coquillett

HABITAT AND DISTRIBUTION: Although *Culex tarsalis* is commonly accepted as a foul water breeder in San Diego County, it is taken from some different habitats. In the mountains it is often found in clear cold water where no pollution exists, and in the desert it can be observed breeding in abandoned irrigation ditches containing seepage water.
LARVAL ASSOCIATES: In the desert it has been found with *Aedes vexans, Psorophora confinnis, Aedes*

Fig. 1. A typical breeding pool for *Culex quinquefasciatus, Culex pipiens or Culex stigmatosoma.* Origin of water was an overflow from a swimming pool shower.

dorsalis, and Anopheles pseudopunctipennis. Culex stigmatosoma, Culex pipiens and *Culex quinquefasciatus* are its closest associates in foul water, whereas in clear cool water it may be found with *Culex erythrothorax* and *Culiseta inornata.*

SPECIFIC DATA: It has been found breeding in water with a saline concentration of 8900 ppm, expressed in total chlorides.

Culex thriambus Dyar
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: Generally this species is collected from marshes, or marshy ponds. It never has been taken from large bodies of water, or from flowing streams. It prefers small quiet pools, hoof prints or depressions filled with seepage water and does not breed in foul water. It, however, is often taken from tea-colored water having a high concentration of organic substances. This species is a cool season breeder, for the most part.

LARVAL ASSOCIATES: *Culiseta maccrackenae, Culex restuans.* Often with *Culiseta inornata* or *Culiseta incidens.*

ABUNDANCE: Fairly common.

Culiseta incidens Thomson
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: The writer has found this species breeding only in warm months generally with *Culex tarsalis,* and being replaced in the same pools during the colder months by *Culiseta inornata. Culiseta incidens* is often collected from artificial containers about residences.

LARVAL ASSOCIATES: *Culex tarsalis.*

ABUNDANCE: Not too common, probably best described as occasionally found in San Diego County.

Culiseta inornata Williston
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: This is a common mosquito throughout the entire county and breeds in various types of habitats. It has been found in slightly foul water. It is most commonly found in the cooler months, when it is the dominant species; and often the only species in some pools. *Culiseta inornata* breeds in small ponds and breeds heavier in the cooler months. It has been collected at sea level and at altitudes as high as 4500 feet.

LARVAL ASSOCIATES: *Culiseta maccrackenae, Culex tarsalis, Culex erythrothorax* and at times with *Anopheles maculipennis freeborni.*

Culiseta maccrackenae Dyar & Knab
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: The writer has found this species in San Diego County at sea level and at the high altitudes. Adults have been collected in Sorrento Canyon, whereas larvae have been taken from the following places: a marsh in the San Luis Rey River near Bonsall, in the same river near its headwaters where the stream is a series of rapids, in springs almost at the top of Mt. Palomar, and in meadow pools in the Cuyamaca section of the Laguna Mountains. It has been collected from such places in the summer and in fall, and was quite common, being the dominant species in certain pools.

LARVAL ASSOCIATES: *Culiseta incidens* and *Culex apicalis.*

SPECIFIC DATA: Although the larvae of this mosquito have not been collected in pools at sea level or at least at lower altitudes than Highland Valley (altitude of 1350 feet), it is quite interesting to find adults at such places as a barn collection station near the mouth of Sorrento Canyon, a few feet above sea level.

Aedes dorsalis Meigen
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: This species has been encountered in only one place in San Diego County. The location was a high tide pool on the grounds of Ream Air Field, near the Mexican border south of San Diego. Although many attempts have been made to find other breeding places of this species, particularly along the coast in high tide pools, none has been found. Larvae have been collected from irrigation ditches in Imperial County breeding with *Aedes vexans.* (See *Aedes vexans* data.)

LARVAL ASSOCIATES: *Aedes vexans* in the desert. in high tide saline pools, concentration of 8900 ppm (total chlorides), it was followed by a brood of *Culex tarsalis* and *Anopheles pseudopunctipennis franciscanus.*

SPECIFIC DATA: As far as this writer is informed (4) (5) this is the southern-most record of this species for the West Coast. The record of its breeding in the desert with *Aedes vexans* is unusual.

Aedes increpitus Dyar
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: Only one record is established by this writer for this mosquito; however, it undoubtedly occurs in other places in San Diego County which have not been encountered. The larvae of this species were found in a sunken rain pool at the base of a sycamore tree in San Clemente Canyon.

LARVAL ASSOCIATES: None.

ABUNDANCE: Rare.

Aedes squamiger Coquillett
(Det. W.C.R.)

HABITAT AND DISTRIBUTION: The adults of this species have been collected from Presidio Park in the city of San Diego, and from a barn collecting station near the mouth of Sorrento Canyon. Larvae have been found in only one location, that being a high tide pool beside Route 101 highway on Mission Bay in San Diego. They have not been found breeding with *Aedes taeniorhynchus,* but have followed a brood of this species in the same pool.

LARVAL ASSOCIATES: None. Probably does occur with *Aedes taeniorhynchus* in this area.

ABUNDANCE: Uncommon.

Aedes taeniorhynchus Wiedemann
(Det. W.C.R.)

Habitat and Distribution: The common high tide breeder of the coastal section of San Diego County. Has proven to be a nuisance in a residential section near its breeding grounds, and adults have been found at Green's Farm, Camp Elliot, which is between eight and ten aerial miles distant from the brackish pools where they breed.

Larval Associates: Probably *Aedes squamiger,* but no data has been collected.

Abundance: Abundant, a year round breeder, very prolific in the summer.

Aedes varipalpus Coquillett
(Det. W.C.R.)

Habitat and Distribution: This is the tree-hole breeder of the country. It has been collected from the water caught in trees following the first winter rain. Very common in sycamore trees which have suitable holes for retaining water. The pH of several samples of water read around 8.04.

Larval Associates: None. *Orthopodomyia signifera* (Coquillett) found breeding with this species by Reeves, Riverside County, California, may occur with it, however, none have been observed. (6)

Abundance: Abundant in winter and spring seasons.

Aedes vexans Meigen
(Det. W.C.R.)

Habitat and Distribution: On September 28, 1944, both larvae and adults of *Aedes vexans* were collected in Imperial County near El Centro. The larvae were collected from abandoned roadside irrigation ditches into which water frequently overflowed from the adjacent waterways. The temperature of the water during the collection was 37° C. and all the pools were grassy, without algal mats. Adults were common around residences, bit viciously at dusk, and were readily caught in light traps. *Aedes dorsalis* larvae were collected from the same ditches.

Larval Associates: *Psorophora confinnis, Culex tarsalis, Aedes vexans,* and *Anopheles pseudopunctipennis franciscanus.*

Abundance: Abundant.

Specific Data: The species is generally considered a flood water breeder which prefers wooded area pools, particularly shady. It, therefore, is quite unusual to find this species in warm water in the desert.(4)

Psorophora confinnis Lynch-Arribalzaga
(Det. W.C.R.)

Habitat and Distribution: This species prefers roadside ditches, abandoned irrigation ditches, or overflow puddles on roads. The writer has found it only in the desert, a heavy breeder in the area of Imperial County, near El Centro City. It is easily caught by a light trap.

Larval Associates: *Culex tarsalis, Aedes vexans, Anopheles pseudopunctipennis franciscanus.*

Abundance: Abundant in the desert.

Fig. 2. Roadside pool in Imperial County in which *Psorophora confinnis was found* breeding. Origin of water is overflow from field irrigation.

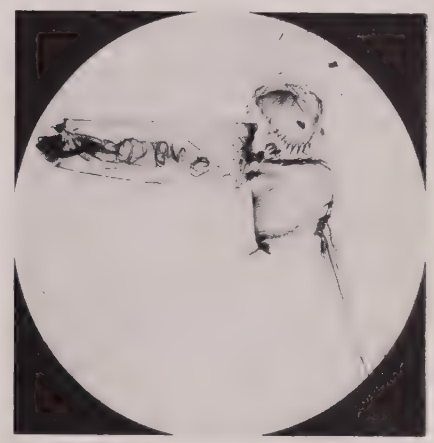

Fig. 3. Posterior segments of *Uranotaenis anhydor* Dyar larva. A photomicrograph.

Uranotaenia anhydor Dyar
(Det. W.C.R. & A.S.)

On September 15, 1944, one third instar larva of *Uranotaenia anhydor* was collected from a grass-tule marsh in the river bed of the San Luis Rey River, four miles upstream from Bonsall, California. The single larva was taken from

hoof prints in a grassy area where cattle were grazing and was associated with two other species, *Culex thriambus* and *Anopheles maculipennis freeborni*. The former species was common, where the latter was but an occasional collection in the marsh. Although at the time no larva were taken, *Culex erythrothorax* adults were caught on the wing in this location.

Dyar reported: "A single larva was obtained in a swamp full of reeds (Sweetwater Junction, San Diego County, June 1906), associated with *Anopheles occidentalis* (*maculipennis*), *Anopheles pseudopunctipennis, Culex tarsalis,* and *Culex erythrothorax*."(7)

The breeding water was tea colored, was but a few inches deep in the hoof prints, and the bottom was of a muck-sand composition, typical to most marshes of stream bottomlands of southern California. *Gambusia affinis,* the top minnow was abundant in the larger pools of the stream; yet rarely were observed in hoof prints where most of the breeding existed.

In the laboratory Charles S. Richards, a coworker of the writer, observed the single larva of *Uranotaenia anhydor* to be predaceous on other larvae: therefore two third instar *Culiseta maccrackenae* were placed with the larva and soon appeared to be eaten by it, although they were considerably larger in size. Other persons* observed this action; however, doubt remains in their minds whether or not it was an act of predaceousness. It is possible that something killed the larva on which the *Uranotaenia anhydor* fed; the larva merely feeding on the parts of the dead organisms. Predaceous mosquito larvae generally eat their prey whole; therefore this condition, if an example of a predator, is indeed a new conception or method of a mosquito larvae preying on others. Following two days of feeding the specimen pupated; however two days later was found dead in the container. The larval skin was mounted in a chloral hydrate preparation and final identification was made from it.

In his publication "Mosquitoes of California"(4), Freeborn stated the following about this species:

*Lt. O. K. Scott, MC, USNR, and writer.

Fig. 4. Marsh in San Luis Rey River near Bonsall, California, where the author collected the single larva of *Uranotaenia anhydor* Dyar.

"This species was named *anhydor* by Dyar on account of the fact that, when he attempted to collect more specimens, he found that the pool which had yielded the single type larva had dried. The species is extremely rare. Dyar has bred the adults from larvae collected in a pond at Old Town, San Diego (May, 1916). The original name was proposed for a single larva taken by Dyar and Caudell (Sweetwater Junction, San Diego Co., June 1905) which died before pupating. The writer was fortunate in seeing a single female taken at Camp Kearney (near San Diego) in May, 1918. This specimen was taken in a large packing box placed near a fresh-water crew for the purpose of affording a collection point in the otherwise barren terrain. It was in perfect condition and gave indication of having emerged but a short time before capture."

The marsh from which this species was collected was revisited six times later, but no other specimens were found. This record is only the fourth time *Uranotaenia anhydor* has been collected, all being within San Diego County.

Description of Specimen From Larval Skin..

Length 5 mm. Head elliptical, bulging at the eyes, as long as wide, front prominent; antennae small, slightly thickened at base, scarcely spinous; upper head hair ?*, the lower a single coarse spine-like hair; anteantennal tuft multiple, well developed. Lateral abdominal hairs long and coarse on first and second segments, fine, multiple and short on succeeding ones; subdorsal hairs ?.* Air tube about three or slightly more) times as long as wide, very slight taper; pecten of 16 evenly spaced brush-like, feathered, teeth in one room; the other row with 18 teeth. Air tube with a black basal ring, single large tuft at middle just beyond pecten. Anal segment ringed by a plate, slightly longer than wide, the chitinous plate excavated to hold a short ventral brush, spinous along its posterior margin; dorsal tufts of three long divided hairs on each side; ventral brush long, but not extending far onto side of segment, confined to the barred area; anal gills (number of?*) not as long as anal segment. Lateral plate of eight (8) segment, comb of nine (9) sharp, thorn-like teeth on its posterior border, those near the center longer than the others. Teeth with fine lateral feathering.

Determination of species was made by Dr. Alan Stone, National Museum, and Dr. W. C. Reeves, Hooper Foundation.

*Not discernable on specimen.

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The library of San Diego Natural History Museum was available to the writer during the course of this study through the courtesy of Clinton G. Abbott, Director.

COLLECTION RECORDS OF *MANSONIA TITILLANS* (WALKER) AND *MANSONIA INDUBITANS* DYAR AND SHANNON IN FLORIDA WITH KEYS TO THE SPECIES OF *MANSONIA* IN THE UNITED STATES. (DIPTERA, CULICIDAE)

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Many Florida records of *Mansonia titillans* (Walker) are found in the literaure, but recent work by Harry D. Pratt (in press) shows that the identification of many of the specimens comprising these records is doubtful. A number of Florida specimens examined by Pratt, including a reared series from Boca Raton, were all *Mansonia indubitans* Dyar and Shannon, representing the first United States records of this West Indian and northern South American species. *Mansonia indubitans* is very similar to *M. titillans,* with which it may be easily confused; therefore Pratt's observations questioned the validity of the past United States records, which probably were in many cases based upon specimens of *M. indubitans* whose identity had gone unnoticed.

Large numbers of adults of *M. titillans-indubitans,* together with occasional collections of larvae, have been submitted to the Fourth Service Command Medical Laboratory from Florida Army installations during the past three years. Since there is now a need for definite locality data on both *M. titillans* and *indubitans,* these collections, together with others made by Edwin L. Seabrook at West Palm Beach and a few specimens gleaned from private collections, have been reidentified (Table 1) according to the following pertinent key characters for the species of *Mansonia* occurring in the United States:

LARVAE

1. Lateral spine of maxilla smooth; anal segment about twice as long as wide; antenna with a pair of short setae arising near middle of shaft, extending less than half-way to tip ..... *perturbans*

   Lateral spine of maxilla strongly serrated on one side; anal segment about three times as long as wide; antenna with a pair of long setae arising near middle of shaft, extending to tip 2

2. Comb scales (at least the larger ones on dorsal half of comb) long, slender, thornlike, with a few minute spinules basally..... ..... *titillans*

   Comb scales rather short, broad, fringed apically with stout subequal spines....*indubitans*

ADULT FEMALES

1. Postspiracular bristles absent; segment 1 of hind tarsus with a pale ring near middle; 8th abdominal tergite unspined..... *perturbans*
   Postspiracular bristles present; segment 1 of hind tarsus without a pale ring near middle; 8th abdominal tergite bearing two irregular transverse rows of short stout peg-like spines (Since the 8th abdominal segment is retracted within the 7th, these spines are not visible unless the tip of the abdomen is clipped off, softened in KOH and dissected)..... 2

2. Palpus a little more than 1/3 as long as proboscis, with 4th segment about twice as long as 3rd; apical margin of 7th abdominal tergite bearing a close-set row of minute, pointed spines (visible on pinned specimens with dissecting microscope); spines of 8th abdominal tergite clumped posteriorly..... *titillans*

   Palpus less than 1/3 as long as proboscis, with 4th segment about 1½ times as long as 3rd; apical margin of 7th abdominal tergite without minute spines; spines of 8th abdominal tergite more or less uniformly spaced..... ..... *indubitans*

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MALE TERMINALIA

1. Dististyle without a tooth-like branch arising from inner margin; lobes of 9th tergite distinct, about as long as broad, widely separated, each bearing several short stout setae.... *perturbans*

   Dististyle with a tooth-like branch arising from inner margin; lobes of 9th tergite indistinct, without setae 2

2 Dististyle broad and thick at base, gradually becoming narrower and thinner to tip, not convoluted ..... *titillans*

   Dististyle broad and thick at base, becoming a little narrower and abruptly much thinner beyond basal third, somewhat convoluted (about ¼ to ½ turn)..... *indubitans*

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TABLE 1. Collection Record of *M. titillans* and *M. indubitans* in Florida
(M = males, F = females, L = larvae)

Date and Location	*M. titillans*			*M. indubitans*		
	M	F	L	M	F	L
Avon Park, Fla.						
1931						
Sept.	..	..	..	..	..	1
1944						
July	..	..	..	..	2	..
Aug.	..	..	..	0	6	..
Sept.	..	..	..	1	1	..
Oct.	..	1	..	..	2	..
Boca Raton, Fla.						
1943						
Aug.	..	1	..	..	1	..
Sept.	..	..	..	..	1	..
Oct.	..	..	..	..	..	5
Nov.	..	..	..	..	..	3
Dec.	..	..	..	..	1	3
1944						
Jan.	..	..	..	..	2	11
Mar.	..	1	..	1	..	..
Apr.	..	..	..	..	6	..
May	..	..	..	..	6	..
June	..	1	..	6	13	7
July	..	5	..	5	42	1
Aug.	1	4	..	22	76	..
Sept.	2	26	..	22	140	..
Oct.	1	42	..	7	56	..
Nov.	..	29	..	10	44	..
Dec.	..	6	..	..	18	..
1945						
Jan.	..	..	..	..	1	..
Mar.	..	4	..	..	6	..
Apr.	..	..	..	..	1	..
May	..	1	..	..	1	66
June	..	3	..	..	..	..
Fort Pierce, Fla.						
1939						
July	..	..	..	1	..	1
Hobe Sound, Fla.						
1943						
Aug.	..	2	..	.	1	..
Sept.	..	..	..	..	2	..
1944						
Aug.	..	2	..	1	5	..
Sept.	..	1	..	..	1	..
Melbourne, Fla.						
1933						
March	..	..	..	..	..	1
Okeechobee, Fla.						
1931						
July	..	..	..	..	..	2
Sarasota, Fla.						
1945						
May	..	..	..	26	54	..
June	..	..	..	2	13	..
W. Palm Beach, Fla.						
1943						
July	..	1	..	..	..	..
Aug.	..	1	..	..	..	..
Sept.	0	3	..	..	..	..
1944						
March	..	1	..	..	..	..
May	1	2	..	..	..	..
June	..	2	..	..	..	..
July	..	5	..	..	1	..
Aug.		16	..	1	..	..
Sept.	1	18	..	..	12	..
Oct.	..	6	..	1	..	..
1945						
Jan.	0	3	..	..	..	8
Feb.	..	7	..	..	..	..
Mar.	..	..	1	12	16	22
May	.	.	25	..	..	154

THE EFFECT OF DRYING ON THE VIABILITY OF *AEDES* MOSQUITO EGGS

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The predominating species of *Aedes* mosquitoes found in the lower Columbia River basin lay their eggs in damp, shady locations. The amount and kind of duff found in these places will vary as will the degree of decomposition. This soil is rich in humus. The moisture-absorbing properties are high, and the water is tenaciously held. Even when the soil appears rather dry, it still contains considerable moisture. Undoubtedly some of the eggs are laid in unfavorable locations and some are destroyed during periods of drouth, but the retentiveness of moisture in the duff and the natural resistance of mosquito eggs to drying prevent the destruction of any large number of eggs.

In reporting his studies on the resistance of *Aedes flavescens* Müller eggs to unfavorable conditions, Hearle (1) states that "The eggs are fairly resistant to superficial dryness over long periods, if dried out slowly and kept in a cool moist place . . . Under natural conditions, soil moisture, even in apparently dry ground, would doubtless be sufficient to prevent eggs from shriveling, and would permit them to remain viable for long periods, probably several years." Mail (2), after holding eggs of several species of *Aedes* (including *A. vexans*) in glass vials without moisture in a cold chamber at 0-10° C. for varying periods up to 20 months, found that some of these eggs would still hatch when they were flooded with water.

The moisture content of field samples containing large numbers of eggs of *A. vexans* (Mg.) and *A. lateralis* (Mg.) taken from topsoil in the lower Columbia River Valley has been determined on two occasions by drying in an oven at 85-90° C. to constant weight. All the samples were from typical breeding areas, and were collected early in the spring, while the soil was still well saturated with moisture, but before the annual spring flood had covered the river bottom. In three samples taken at Waukeena Falls, Hayden Island, and Sauvies Island between April 6 and 11, 1933, the water content was found to be 39, 34 and 48 per cent. One sample taken at Hayden Island on March 14, 1944 showed 36 per cent of moisture, and another sample taken on the same day on this island, but in a very wet area close to a small pond, showed 46 per cent. The latter contained fewer eggs than the other samples. These data indicate that the average moisture content of the surface layer of soil, which contains the mosquito eggs, is about 40 per cent. None of these samples, except the one last mentioned, appeared excessively wet or fully saturated. The water capacity of any sample depends largely on the amount and kind of duff present, and the degree of decomposition of the vegetable matter.

A large number of soil samples have been handled at the Portland, Oreg., laboratory in the last 14 years. Observation and experience have shown that these humic soil composites are very retentive of moisture, and that viable eggs may be found in very dry soils. Often weeks and months elapse before the moisture content of stored samples drops sufficiently to injure the eggs. Laboratory experiments have shown that the eggs lose their viability rapidly, if they are removed from the soil. In April 1933 several tubs of dirt containing large numbers of mosquito eggs were brought to the laboratory. Of these eggs 63 per cent were *A. vexans* and 37 per cent were *A. lateralis*. This soil contained 48 per cent of moisture. Only a portion of this soil was used, and the tubs remained uncovered in a basement storeroom until the following spring. This storeroom has no windows, is dry, and

has a uniform temperature close to 70° F. In April 1934, when the soil was tested again, it contained 4 per cent of water. When samples of the soil were flooded, numerous larvae were obtained. Most of these larvae were reared to the fourth instar, and a few to pupae and adults. Identification of the larvae showed that 64 per cent of the eggs hatching were *A. vexans* and the remainder *A. lateralis*.

In March 1943 a pail of dirt containing many eggs was collected for laboratory use. About half of this dirt was used, and the remainder stood uncovered in the laboratory until the following August. At this time the dirt was dry and dusty, but 3-quart pans about half full of this dirt when flooded gave 2 to 300 larvae each, as compared with 8 to 1,000 larvae obtained from the fresh soil when it was flooded in March.

A project was outlined in 1944 to determine the relationship between the loss of soil moisture and the decrease in the viability of the mosquito eggs, and also to find out how dry the soil must become before the eggs are destroyed. Topsoil was obtained from Hayden Island (sample containing 36 per cent of water), and the coarser debris and dead leaves were screened out. A moisture determination was made, and duplicate 1-quart samples were flooded. The remainder of the dirt was put in a 5-gallon pail, covered with muslin, and stored in the basement room. At intervals throughout the year the soil was thoroughly mixed and portions of it were removed for moisture determinations and for flooding. Table 1 gives the results of these tests.

It appears evident that the soil moisture had been reduced to the critical point by December 26. At this time a number of the eggs hatched, but when the soil was flooded a month later only nine larvae were found. These tests show that the eggs of these species may survive for long periods in dry soil, but that they are soon desiccated by the depletion of the soil moisture to below 3 per cent. As the moisture content of the soil decreased, the ratio of the larvae of the two species was reversed, and by January 22, 1945, only *A. lateralis larvae* appeared. This indicates that the eggs of *A. lateralis* remain viable longer than do the eggs of *A. vexans*.

Summary

The humic topsoil containing the eggs of *Aedes vexans* (Mg.) and *A. lateralis* (Mg.) has excellent water-absorption properties.

Samples collected in March and April of two different years had an average moisture content of about 40 per cent. This water is tenaciously held, and months of air drying are required to reduce the water content to a point where the viability of the eggs is greatly decreased. However, after the moisture content has been reduced to below 3 per cent, the loss of viability is rapid. The eggs of *A. lateralis* appear to be more resistant to drying than are those of *A. vexans*.

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Table 1. Relationship Between Loss of Soil Moisture and Decrease in Viability of Mosquito Eggs. Each Figure Represents the Average of Two Samples

Date Tested	Moisture Content of Soil	Moisture Loss in Soil	Larvae Found	*A. vexans*	*A. lateralis*	Reduction in Viable Eggs
1944	*Per Cent*	*Per Cent*	*Number*	*Per Cent*	*Per Cent*	*Per Cent*
March 14	36	....	455	72	28	
May 29	27	25	424	90	10	7
Sept. 16	17	53	339	80	20	25
Dec. 26	3	92	149	44	56	67
1945						
Jan. 22			9	0	100	98
Feb. 20	2	93	0	0	0	100

DDT RESIDUES ON VEGETATION AND GROUND LITTER FOR CONTROL OF ADULT SALT-MARSH MOSQUITOES

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The effectiveness of spray residue treatments containing DDT (1-trichloro-2,2-bis-(p-chlorophenyl)ethane) in buildings against the common malaria mosquito, *Anopheles quadrimaculatus* Say, under both laboratory and field conditions has been determined by Gahan *et al.* (1945a, b, c). The effect of such treatments on the incidence of malaria has not been determined, but it is reasonable to believe that a substantial reduction of the disease would result.

Since many species of pest and disease-carrying mosquitoes are known to have sylvatic resting places, an investigation on the efficiency of treating the vegetation in jungles with DDT appeared worthwhile. It was believed that the armed forces could utilize this method of control by spraying with ground equipment the vegetation in and around camps, airfields, and bivouac areas.

Experimental Methods and Conditions.—Tests were made near Cocoa Beach, Fla., during the summer of 1944 against adults of the salt-marsh species *Aedes taeniorhynchus* (Wied.) and *A. sollicitans* (Walk.), in a rather dense jungle growth containing a preponderance of cabbage palms and oak with an undergrowth of saw palmetto and low hammock shrubs.

Square plots, either ½ or 1 acre in size, were treated by applying the material to the foliage of the undergrowth and up to a height of about 5 feet on the tree trunks. Much of the spray also fell on the litter of dead leaves lying on the ground. Applications were made with 3-gallon, hand-operated, compressed-air sprayers. Nozzle disks having 3/64-inch apertures discharged approximately 1 gallon of liquid in 8 minutes. Sprays were applied in swaths from 15 to 20 feet in width, back and forth across the plots to insure complete coverage. The objective, as in the treatments in buildings, was to establish a residue of DDT on all surfaces upon which the mosquitoes might rest. Dosages were determined on the basis of the number of gallons of spray per acre rather than on the number of milligrams of DDT per square foot, which was the basis for determining the dosage rate in buildings.

The results were evaluated by counting the mosquitoes on the front of a man's trousers at the end of a 1-minute exposure. A count of the landing rate provides an excellent index of the population density in any given area. At each observation period a number of these counts were made at random in the plots and in the surrounding untreated areas. In this way the percentage control or reduction resulting from the treatment at any given time was determined. Counts usually were made early in the afternoon.

Since the tests were conducted during the rainy season, the treatments were subjected to an abundance of rainfall. All treatments, however, were applied at least 12 hours before any rain fell. The official Weather Bureau record of precipitation for the period of the investigations, taken at the Merritt Island station, about 3 miles from the plots, is as follows: July 9.32, August 7.70, and September 6.53 inches.

In addition to the effect of rainfall, considerable new growth appeared in the plots and much untreated litter fell to the ground before the observations were terminated.

[1] This work was conducted under a transfer of funds, recommended by the Committee on Medical Reesarch, from the Office of Scientific Research and Development to the Bureau of Entomology and Plant Quarantine.

The authors wish to acknowledge the able assistance of Charles Lewis and Charles Wood, Jr., in the conduct of these investigations.

Effect of Various Dosages and Concentrations of DDT Sprays and Emulsions.—In the first experiment a solution consisting of 5 per cent of DDT[2] in No. 2 fuel oil was applied to three 1-acre plots at rates of 3, 5, and 10 gallons per acre. Some difficulty was experienced in obtaining complete coverage of an acre with 3 gallons of spray, and in the plot treated with 10 gallons the application was somewhat spotted owing to the dense undergrowth of palmettos. A landing rate in the plots of 200 mosquitoes per minute was recorded immediately before treatment, which was one of the highest counts of the season. In this and in subsequent experiments there was a marked reduction in the mosquito population shortly after the treatments were applied.

A record of mosquito reduction in the plots at approximately weekly observation periods is presented in table 1. Similar results were obtained in all the plots up to 17 days after treatment. Beyond that time reduction was usually less in the plot treated with 3 gallons per acre, although the difference was not always great enough to be considered significant. There was a definite drop in the effectiveness of the heavier dosages after 82 days, and general observations 102 days after treatment (not given in table) showed little or no reduction in any of the plots. The dosages of 5 and 10 gallons per acre were equally effective during the entire period.

To determine the duration of effectiveness of a relatively heavy dosage of DDT, a 5-acre plot was sprayed with 5 per cent of DDT in No. 2 fuel oil at the rate of 20 gallons per acre. One half of this plot was located in the jungle and the other half in an open, nearly treeless marsh. Landing-rate counts on the open marsh were made in the shelter of the few trees that were present, since the adults of these species generally remain in the shade during the daytime.

Counts were begun in this plot and the surrounding untreated area 3 days after the spraying and were continued at intervals of approximately 1 week until 76 days after the treatment, when the natural reduction in mosquitoes terminated the test. A high reduction was maintained throughout the test period (table 2), but the total time over which such a heavy deposit would have been effective was not fully determined. Undoubtedly it would have been effective several weeks longer. It should be pointed out, however, that the application of 20 gallons of spray per acre with hand equipment under jungle conditions represents an extremely laborious task.

[2] All concentrations of DDT are in terms of weight per volume.

TABLE 1. Reduction of Adult Salt-Marsh Mosquitoes in 1-acre Jungle Plots Sprayed with 5 per cent of DDT in No. 2 Fuel Oil at Various Dosages.

Time After Treatment	Reduction at Indicated Dosages Per Acre		
	3 Gallons	5 Gallons	10 Gallons
Days	*Per Cent*	*Per Cent*	*Per Cent*
2	99	97	95
9	90	89	98
17	91	87	86
27	67	92	92
34	64	79	72
40	55	67	72
47	41	62	65
54	59	66	65
75	64	63	59
82	28	76	67
91	26	50	40

TABLE 2. Reduction of Adult Salt-Marsh Mosquitoes in a 5-acre Plot Sprayed with 5 per cent of DDT in No. 2 Fuel Oil at the Rate of 20 Gallons per Acre.

Time After Treatment	Reduction in—	
	Jungle Area	Open Marsh
Days	*Per Cent*	*Per Cent*
3	99.8	93
9	97	95
15	96	94
23	88	96
30	85	83
39	91	94
51	88	86
56	86	77
65	92	80
76	86	80

An aqueous emulsion and a fuel-oil solution containing 5 per cent of DDT were compared by spraying two adjoining 1-acre plots at the rate of 5 gallons per acre. The results presented in table 3 indicate that DDT was slightly more persistent when applied in an emulsion than in a solution.

TABLE 3. Reduction of Adult Salt-Marsh Mosquitoes in 1-acre Plots Sprayed with a Fuel-Oil Solution and an Aqueous Emulsion Containing 5 per cent of DDT at the Rate of 5 Gallons per Acre.

Time After Treatment	Reduction in Plot Treated With—	
	Solution	Emulsion
Days	*Per Cent*	*Per Cent*
2	96	98
5	84	95
9	82	88
15	52	79
22	62	57
26	78	89
33	60	55
40	44	62
61	64	34
77	48	80

In another experiment three adjoining ½-acre plots were treated at various rates with a fuel-oil solution containing DDT, one plot with 5 and two plots with 20 per cent DDT. An additional ½-acre plot was treated with an aqueous emulsion containing 5 per cent of DDT. Results given in table 4 show that the differences between treatments were too slight to be considered significant. However, random samples of foliage and ground litter were collected in each of the plots 50 days after treatment, and caged houseflies (*Musca domestica* L.) were exposed to these samples for 6 hours in the laboratory. The emulsion killed all the flies in 1 hour and the 5-gallon dosage of the 20 per cent DDT-fuel oil solution killed them all in 6 hours. At the end of the 6 hours the mortality was 8 per cent from the 10-gallon application of 5 per cent DDT and 17 per cent from the 2½-gallon application of 20 per cent DDT. This indicates that the residue retained a high degree of toxicity over the longest period in the plot treated with the emulsion.

Effect of a Barrier Treatment.—To determine the protective value of a treated barrier surrounding an untreated area, a 100-foot strip around an untreated ½-acre plot was sprayed with 5 per cent of DDT in No. 2 fuel oil at the rate of 10 gallons per acre. Since adult mosquitoes present in the untreated inner plot were killed with a liquefied-gas pyrethrum aerosol when the barrier strip was treated, those subsequently found there probably had crossed the treated barrier. It appeared possible that adults crossing the barrier would make this flight in short stages, and thereby rest on the treated foliage long enough to obtain a lethal dose.

The results of this experiment are given

TABLE 4. Reduction of Adult Salt-Marsh Mosquitoes in Four ½-Acre Plots Treated with DDT Solutions and an Emulsion at Various Concentrations and Dosages

Time After Treatment	Reduction at Indicated Concentrations and Dosages per Acre			
	Fuel-Oil Solutions			Emulsion
	5 per cent DDT	20 per cent DDT		5 per cent DDT
	10 gallons	2½ gallons	5 gallons	5 gallons
Days	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*
2	97	99	91	89
9	95	86	88	90
16	93	93	80	75
23	87	92	47	58
32	73	89	89	92
43	76	56	61	56
50	48	82	47	48
59	69	61	84	72

in table 5. A fairly satisfactory reduction was maintained in the untreated plot up to 27 days after treatment of the barrier, and there was good reduction in the barrier up to 85 days. This leads to the conclusion that, in dealing with species having a shorter flight range than salt-marsh mosquitoes, particularly if a barrier wider than 100 feet is used, a satisfactory degree of protection might be obtained for a reasonable length of time by the use of this method.

TABLE 5. Reduction of Adult Salt-Marsh Mosquitoes in a Barrier Treated with 5 per cent of DDT in No. 2 Fuel Oil at the Rate of 10 Gallons per Acre, and in the Untreated ½-Acre Plot Surrounded by the Barrier.

Time After Treatment	Reduction in	
	Treated Barrier	Untreated Inner Plot
Days	*Per Cent*	*Per Cent*
3	....	78
11	95	59
19	87	49
27	92	57
33	91	26
41	83	21
48	80	0
57	89	49
69	56	34
76	47	0
85	76	22
96	28	0

Comparison of Methods of Application.—An experiment was made to determine whether it is necessary to apply the spray to both the foliage and the ground litter, or is sufficient simply to spray the litter alone. Two adjoining 1-acre plots were treated with 5 per cent of DDT in No. 2 fuel oil at the rate of 10 gallons per acre. In one plot the spray was applied to the foliage and tree trunks in the manner previously described, and in the other it was applied to the ground litter only. No appreciable difference in effectiveness between the two methods was recorded up to the end of the experiment, 73 days after treatment (table 6). Thus it is apparent that to obtain a reduction of adult salt-marsh mosquitoes it is only necessary to spray the ground litter under which they rest during the daytime. This emphasizes the need of a knowledge of the resting habits of the species involved in determining the most efficient method of applying the residue treatment, since it is unnecessary to treat surfaces other than those on which the mosquitoes will rest.

TABLE 6. Comparative Reduction of Adult Salt-Marsh Mosquitoes in 1-acre Plots Treated with 5 per cent of DDT in No. 2 Fuel Oil, Applied to Ground Litter and Foliage or to Ground Litter Only, at the Rate of 10 Gallons per Acre.

Time After Treatment	Reduction with Solution Applied to—	
	Ground Litter Only	Ground Litter and Foliage
Days	*Per Cent*	*Per Cent*
1	98	97
3	96	96
9	99	92
16	83	89
21	90	90
28	87	71
35	74	82
44	56	82
56	64	64
63	57	53
72	75	75

Summary and Conclusions.—Investigations were undertaken near Cocoa Beach, Fla., during the summer of 1944 to determine the effect of residue from DDT spray treatments on the abundance of adults of the salt-marsh species *Aedes taeniorhynchus* (Wied.) and *A. sollicitans* (Walk.) when applied to jungle areas. In the majority of tests 5 per cent of DDT in No. 2 fuel oil was applied to 1-acre plots at the rate of 3 to 10 gallons per acre, although some studies were made of higher concentrations at 2½ to 5 gallons per acre and of the 5 per cent concentration at 20 gallons per acre. A 5 per cent DDT aqueous emulsion also was tested.

The results show that 5 gallons per acre of 5 per cent DDT constitutes a satisfactory dosage, and that the emulsion is slightly more effective than the solution. Good reduction of adult mosquitoes was maintained in some plots for as long as 2½ months after application of the spray. Tests of a barrier treatment indicate that

this method could be used successfully against species less active than salt-marsh mosquitoes. Comparative tests of methods of application show that against these species it is sufficient to spray the ground litter alone. Thus the importance of a knowledge of the resting habits of the species involved is apparent, since obviously it is unnecessary to treat surfaces other than those on which the mosquitoes will rest.

The results of this work show that the residue from DDT spray treatments in jungle areas affords a promising means of controlling adult mosquitoes possessing sylvatic resting habits.

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DEATH NOTICE

John Harrison Spackman, for the last nine years a Supervisor of the Delaware County Mosquito Extermination Commission in Pennsylvania, died on April 5, 1945, at his home, 105 Morton Avenue, Rutledge, Pennsylvania, which is near Swarthmore.

Mr. Spackman had been in poor health for several months, but had been apparently feeling better for a considerable period prior to his death. He died of a heart attack. Mr. Spackman was a graduate of Lafayette College and the University of Pennsylvania Law School. He had been a member of the Government Engineering Staff which surveyed the boundaries of Yellowstone Park before the turn of the century. From 1897 to 1920 he was Claim Agent for the Pennsylvania Railroad. His wife, Helen B. Spackman, survives.

Mr. Spackman, who had been a familiar figure at the meetings of the New Jersey Mosquito Extermination Commission at Atlantic City for many years, had been interested in Entomology and had read widely in this field. He had shown a great deal of interest in the trapping and identification of mosquitoes since his connection with the Delaware County Mosquito Extermination Commission in 1936. He had been a member of the American Mosquito Control Association and was known and liked by the many members who had come in contact with him.

Mr. Spackman had taken a special interest in the recent work which he had done in the schools of Delaware County, lecturing and showing films on mosquito control in many of the high schools and elementary schools of the county. He was engaged in this work up until the day before his death. R.W.G.

COMMUNICATIONS

A LETTER FROM THE PRESIDENT

BUREAU MOSQUITO CONTROL
DEPARTMENT PUBLIC WELFARE
Norfolk, Virginia

July 25, 1945.

To the Membership of the American Mosquito Control Association

Dear Fellow Member:

It is unfortunately true that restricted travel may likely preclude any general meeting of the Association this year as well as the more informal inspection trips and regional gatherings of the past where friendly discussion and personal contacts have done so much to strengthen our organization.

Under such conditions the responsibility for maintaining our high standard of recognized usefulness throughout the country by our cooperative efforts rests more heavily than usual on our official publication, Mosquito News. Contributions from the membership are not only welcome but are essential. Each of you has an item of news that would be of interest to others of us. If only one other person fully appreciated your item, his satisfaction would well repay the few minutes of your time it cost. It is only by such cooperative efforts that we can make progress during these trying times when we cannot afford to stand still. I shall strive to do my part and I am confident that I can rely on you to do yours.

Since I cannot go visiting, the next best thing would seem to be to address you in this way from time to time when there are matters to be discussed or happenings to be told. Since a general meeting was out of the question, I was inducted into office here in Norfolk and it would seem that a brief summary of what occurred might be of interest to at least some of the membership, so I am taking this opportunity of presenting it for your information.

The rites were conducted in the Council Chamber of the City Hall on Saturday, June 30, and were brief but impressive. His Honor, Mayor Reed, presided and, being a speaker of no mean ability, as well as my personal friend, he performed his task most ably. The committee delegated to perform the induction consisted of the Retiring President, Robert L. Vannote; Dr. H. H. Stage, our new Second Vice-President; Secretary Thomas D. Mulhern; Dr. George A. Comstock, and Lester W. Smith, all of whom arrived by way of Baltimore for the occasion.

The proceedings were opened by invocation of the Reverend John W. Kincheloe, Jr. Mayor Reed then welcomed the out of town visitors to Norfolk, and after a few appropriate remarks he introduced Mr. Vannote, who made a strong and well considered address. At its close he pinned the symbolic badge of office on my coat and wished me well.

After my acceptance, Mayor Reed introduced Rear Admiral Luther Sheldon, Jr., and attorney Tazewell Taylor, each of whom made brief but pertinent remarks. Mrs. Charles C. Day, Past President of the Federation of Garden Clubs of Norfolk and Vicinity, then presented a floral tribute from that organization, and another was received from the Bureau of Parks. The ceremonies closed with a benediction by Reverend Sparks W. Melton.

The visiting members of the Association and myself were luncheon guests of Dr. H. G. Parker, Director of Public Welfare, at the City Welfare Center, and later a tour was made through the Naval Operating Base and the Naval Air Station, ending with an inspection of extensive drainage operations now under way under Navy supervision. Saturday evening a group of us were guests of the Navy at an informal buffet supper which was thoroughly en-

Rear Admiral Luther Sheldon, Jr., President Ruth, Past President Vannote, Mayor James W. Reed of Norfolk offering congratulations.

President Ruth receiving Badge of Office from Past President.

Mayor Reed presiding at induction ceremony.

President Ruth and Mrs. Charles Day, Past President Norfolk Garden Clubs.

Top, left—R. E. Dorer and PHS. Jeep. Top, right—Dr. H. G. Parker and guests at Norfolk City Farm. Center—Equipment is presented to new President at informal initiation.
Bottom, left—The Induction Committee. Bottom, right—Evening relaxation as Navy guests.

joyed by all those present and was a fitting conclusion to the day's activities.

In closing I wish to express to you personally my appreciation for the honor which the membership has done me by entrusting to me its leadership for the coming year. I shall do my utmost to follow the able example of my distinguished predecessor and friend, and with your cooperation and help I believe that our continued progress is assured.

Yours very truly,

PERRY W. RUTH,

President.

Guests at the induction of Perry W. Ruth as President of the American Mosquito Control Association in Council Chamber at Norfolk on June 30, 1945:

Honorable James W. Reed, Mayor of Norfolk.

The Clergy—Dr. Sparks W. Melton, Pastor, Freemason Street Baptist Church; Dr. John W. Kincheloe, Jr., Pastor, First Baptist Church.

The Bar—Captain Tazewell Taylor, Attorney-at-law.

The Press—Joseph R. Bobbitt, Virginian Pilot; Charles Borjes, Virginian Pilot; Charles Hoofnagle, Ledger Dispatch; D. H. Vollmer, Ledger Dispatch.

U. S. Navy—Rear Admiral Luther Sheldon, Jr., Captain J. M. Huff, Captain J. E. Andrews, Lt. Commander Donald MacCreary, C. H. Marsteller, Chief Civilian Sanitary Inspector.

U. S. Army—Major Charles W. Gamble, Major William Caverly, Captain D. W. LaHue, Captain Philip Stone.

U. S. Public Health Service—Roland E. Dorer, Assistant State Director, Malaria Control in War Areas; Lt. Col. M. A. Rowe, Captain William E. Bickley.

Norfolk City—Honorable Joseph D. Wood, former Mayor of Norfolk; C. E. Wright, Councilman; Col. Charles B. Borland, City Manager; Aubrey Graham, Postmaster; Edward W. Bray, Assistant Postmaster; Edwin E. Bibb, Civil Service Commission; George W. Price, Norfolk Housing Authority; George W. Price, Jr., Norfolk Housing Authority; Frederic Heutte, Superintendent of Division of Parks; G. R. McPherrin, Bureau of Mosquito Control; Harry L. Burns, Bureau of Mosquito Control.

Chamber of Commerce—W. S. Harney, Secretary and Manager, Norfolk Association of Commerce; Francis E. Turin, Manager, Norfolk Advertising Board.

Hampton Roads Entomological Society—Dr. H. G. Walker, President; Dr. Victor A. Tiedjens, Director, Virginia Truck Experiment Station.

Federation of Garden Clubs of Norfolk and Vicinity—Mrs. Charles C. Day, Former President; Mrs. Charles L. Voight, Chairman Radio Committee.

Mrs. Robert J. Upton, Co-Chairman of Civilian Defense Volunteer Office, Brooklyn, New York.

Mrs. Julian Delk, Member Camp Committee of Girl Scouts of Tidewater, Virginia.

Mrs. C. R. White, Past President of the Federation of Missionary Societies of Norfolk.

Mrs. J. W. Reed, Member of the Executive Board of the Women's Auxiliary to the Norfolk County Medical Society.

Induction Committee from the Association

Robert L. Vannote, Morris Plains, N. J., Past President, American Mosquito Control Association, Director Morris County Mosquito Extermination Commission.

H. H. Stage, Washington, D. C., Senior Entomologist, Division of Insects Affecting Man and Animals, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

Dr. George A. Comstock, Nassau County, N. Y., Nassau County Mosquito Extermination Commission.

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Lester W. Smith, Metuchen, N. J., Executive Secretary, Middlesex County Mosquito Extermination Commission.

EDITORIAL SECTION

THE POST-WAR OUTLOOK FOR MOSQUITO CONTROL AND RELATED WORK

The "shooting war" has stopped. Millions of our fighting men will soon be home again. But many thousands of these ex-servicemen will, in the course of fighting our war for us, have become walking "culture tubes" or reservoirs of various germs; of microorganisms; viruses, and the like, which are the causative agents of malaria and of other hitherto locally unknown or long absent insect borne diseases, some of which may be transmitted from man to man by insects native to our own home-land.

Most of these diseases can not normally be passed directly from man to man. Such diseases are not "catching" in the usual sense. Association with their ex-serviceman carriers, therefore, is quite free from any danger of such contagion.

The potential insect transmitters, also, are innocuous in the absence of infected human carriers; hence the former absence of such diseases, even where appropriate insect transmitters are locally abundant.

Only when an appropriate insect transmitter has taken an infected blood-meal from a carrier, and then only after an incubation interval characteristic of the causative agent, can the disease normally be inoculated into the body of a healthy man through the "bite" of the infected insect.

Even though our returned ex-service carriers are themselves incapable of passing on to other directly, their particular insect borne infections, wherever they may go, any considerable abundance of the appropriate insect transmitters may constitute a serious local health hazard.

The magnitude of this health hazard in any locality will be determined by the numerical ratio of potential insect transmitters to returned human carriers, and of both to the local population as a whole; for it is on this basis that a normal operation of the law of probability will determine how many of the potential insect transmitters will be likely to take an infected blood-meal, and how many of the resulting infected insects will be likely then to "bite" and thus introduce the causative agent of the disease into the body of a healthy member of the community.

Returned ex-service carriers will settle in almost every community throughout North America and Europe, as well as many parts of South America and other regions of the world. In this way, malaria and other insect borne diseases will be brought into localities where they have been hitherto unknown or long absent; and even in regions where the same or similar insect borne diseases are endemic, new and possibly more dangerous strains of these diseases may be introduced.

As a result, sporadic new cases arising from this source will inevitably appear in many places. Whether these sporadic new cases will develop into local epidemics with attendant cost in loss of manpower, in human suffering, and in human life, and whether any of the so introduced diseases may be able anywhere to maintain itself and thus become locally endemic, will usually depend upon the relative abundance of the appropriate insect transmitters.

To meet this situation adequately will require a tremendous, and even world-wide expansion of mosquito control and similar pest abatement work.

The saving feature in the present situation lies: (1) In the almost universal public and official knowledge of the critical importance of insect borne diseases and their control in war areas; (2) In the fact that most returning service men also, have had knowledge of the benefits from insect control practice; and (3) In the fact that many hundreds of service men have had practical training and experience in

the suppression of mosquito carriers of malaria, and of other insect carriers of disease.

While malaria control has monopolized a great part of public and official attention since World War II began, and while introduced malaria will constitute a large part of the immediate nation-wide, and even world-wide post-war hazard, still other insect borne diseases will complicate the problem of meeting this general post-war menace.

Mosquito abatement commissions will shortly be charged with responsibility not only for control of malaria or of pest mosquitoes as the case may be, but, according to local need, also for control of mosquito-borne encephalitis, of flea-borne plague, of tick-borne spotted fever, and the like. Other pest control problems that require community action may also be added from time to time; a further responsibility which should be welcomed by such public agencies.

With a generally recognized health hazard; with a favorably conditioned public opinion; with a leaven of returned service men who will not have to be "sold" the idea of insect borne disease control; and with a reservoir of experienced men trained to do efficient control work; only energetic leadership should be required to bring about an expansion of mosquito control and related work, the like of which has never before been known.

Where such leadership is met by a tardy official response, as it well may be sometimes, the American Mosquito Control Association and MOSQUITO NEWS may be able to lend helpful support through information relating to existing legislation, and to the steps which should be taken first initiating a sound community program for control of mosquitoes and related pests.

REVIEWS AND ABSTRACTS

A MANUAL OF TROPICAL MEDICINE. By Mackie, Thomas T., Hunter, George W. III. and Worth, C. Brooke; XIX + 727 pp., 287 illustrations, 6 in color. $6.00. Published by W. B. Saunders Company, Philadelphia and London, 1944.

This volume is one of a series developed under the auspices of the Division of Medical Sciences of the National Research Council. In the Preface there are these two significant statements: "The importance of insects and other arthropods as reservoir hosts, intermediate hosts and vectors of many important tropical diseases has led us to devote considerable space to Medical Entomology. This has been done advisedly since few physicians have been trained in this field.

Section X, Medically Important Arthropods, comprises 142 pages, nearly one-fifth of the volume. In addition each chapter dealing with an arthropod borne disease contains further entomological information, frequently a repetition in different form of the material in Section X, however, fully justifiable for epidemiological and prophylactic reasons. In this Manual, as in others in the same field, there is the obvious segregation of entomology as something separate and apart in spite of the statements quoted above. There is not yet the wholehearted cooperation in matters pertaining to epidemiology, experimentation, and prophylaxis. Insect surveys and the use of insecticides typify the province of the entomologist. The entomologist perhaps has not yet earned the full confidence of his medical associates—certainly very few deserve being classed as medical entomologists. Surely those who contributed the section on "Medically Important Arthropods" made an excellent contribution adding much to the value of the Manual. According to the acknowledgments much of the section on Medical Entomology was contributed by Major Gordon E. Davis, Sn. C., and Captain Luther S. West, Sn. C., both capable scientists.

Section X begins with an excellent exposition of the role of arthropods as vectors of disease and a valuable table (Table 49) of human diseases so transmitted. This table is divided into the following parts: (1) Helminthic Diseases, (2) Protozoal Diseases, (3) Spirochaetal Diseases, (4) Bacterial Diseases, (5) Rickettsial Diseases, (6) Virus Diseases, (7) Miscellaneous, such as enteric diseases transmitted by houseflies; also human bots. Then follow two other tables: Table 50, Envenomization (including Allergies) and Table 51, Dermatoses of Arthropod Origin. These tables are excellently set up and very useable. For each disease the

etiologic agent is specified as well as the specific vector, distribution, reservoir and diagnostic procedure: also under envenomization and dermatoses the effects on man are briefly described.

For a manual of this nature the Arachnida are unusually well treated; this section comprises 24 pages. A few additional illustrations would have added much to the value of the section, e.g., further illustrative material pertaining to "soft ticks." To gain further knowledge concerning the tick vectors of the spotted fevers and the relapsing fevers one must consult the appropriate sections dealing with these infections. This procedure, of course, avoids repetition and, no doubt, the authors of these sections did consult medical entomologists familiar with the natural vectors.

The section (pp. 541-646) dealing with the Insect is excellent and reasonably well illustrated. Medically important insects in twelve different orders receive consideration. Two Australian species of Collembola are recorded as attacking man resulting in "irritation and papules similar to mosquito bites with pruritus." The authors have succeeded in striking a fairly good balance between the orders with much emphasis on the Diptera, which is as should be. However one feels that not sufficient emphasis is given to important differences in the breeding habits of anopheline vectors. This is not as bad as it seems because a six page table (Table 23) in the section on "Malaria" takes care of this matter very well indeed. Furthermore in a manual of tropical medicine one would expect a more adequate treatise on tsetse flies. The section on Myiasis is very well done and includes an excellent table (Table 65) on "Types of Myiasis in Man."

The chemical control of arthropods of medical importance is excellently summed up in Table 63 covering four pages. The letters "DDT" appear at least 30 times in this table alone and many more times in the text.

To gain a good notion of the importance of arthropods in the field of tropical medicine one would certainly wish to consult this valuable manual. —W. B. Herms

THE ANOPHELINE MOSQUITOES OF THE AUSTRALASIAN REGION. By David J. Lee and A. R. Woodhill. Publications of the University of Sydney, Department of Zoology, Monograph No. 2, December 15, 1944 (pp. i-xii and 1-209, 13 text figures, XXXIV plates, VIII maps).

Except for the work by Swellengrebel and Rodenwaldt on the anophelines of the Netherlands Indies, which included only the northwestern corner of the Australasian region, there has been no adequate taxonomic treatment of these most important mosquitoes of this region. The present work covers the species of *Anopheles* and *Bironella* found in the Moluccas, Ceram, and Timor and those lands of the Pacific south and east from these islands. Thirty-four species or subspecies are treated in detail, with an illustrated description of the female, male and larva as far as these are known. Under each species there is included a discussion of its biology, relation to disease, and distribution, with a map of the latter. In addition, 12 species reported from the western fringe of the area are discussed briefly. The introductory portion includes remarks on the importance of anophelines, their biology and control, and a very sound discussion of superspecies and infraspecific categories. A well-illustrated section on morphology carefully defines the terms used in the descriptions, and by means of diagnoses and tables the tribe Anophelini is defined as well as the divisions within the tribe. Keys are given to the adults and fourth-stage larvae, and to the eggs of a few species. Of particular interest is a map showing the type localities of all the species and synonyms.

The authors are to be congratulated on the care with which every aspect of the subject has been handled, and it is to be hoped that they will do the same with other genera of mosquitoes. In so excellent a work there is very little to criticize, particularly since the authors admit that it should serve only as a basic work to which inevitable revisions should be added as increase in knowledge makes them necessary. We do feel, however, that they were overly cautious in not recognizing *Anopheles farauti* Laveran as a valid name and in not treating it as a species distinct from *punctulatus* Doenitz. —Alan Stone

STUDIES ON THE ANOPHELINE COMPLEX OF WESTERN AMERICA. By Thomas H. G. Aitken, 1945. Univ. Calif. Publ. Ent. 7 (11): 273-364. 277 ref., illus.

Malaria in Europe often does not occur in areas where *Anopheles maculipennis* Meig., an important vector of the disease, is numerous. Investigators, in attempting to account for the spotty distribution of malaria there, discovered that this species is a complex consisting of six or more subspecies, only a few of which are effective transmitters of this disease. Owing to the widespread interest in the subspecies and varieties of anophelines and the need for accurate knowledge of the disease-bearing insects, the author has studied the possibility of such complexes in *A. maculipennis, A. pseudopunctipennis* Theo., and *A. punctipennis* (Say) in this country.

Following the introduction to this extensive paper is a key to all stages of the anophelines of western America. Although much confusion has existed in the American *maculipennis* group, the author believes that the present time three subspecies of *A. maculipennis* in North America should be recognized: *A. m. occidentalis* (D. and K.), *A. m. freeborni* Aitken, and *A. m. aztecus* Hoffmann. Under each of these subspecies may be found the description of stages, distribution, and a general discussion. The morphological distinctions not only between the life stages but also between the male terminalia of *A. quadrimaculatus* Say and the American races of *A. maculipennis* are pointed out in an extensive

table. It is exceedingly helpful to have such differences tabulated so that ready reference may be made to them. The title of this table is probably in error since it mentions *Anopheles* where it obviously refers to *A. quadrimaculatus.*

The old and new world forms of *Anopheles maculipennis* are compared taxonomically. It is concluded that sufficient differences exist between them to consider them as distinct. The three new world subspecies are then compared as to larval and adult bionomics and disease relationship. In western America the most important vector of malaria is *A. m. freeborni.*

Owing to the variability in the *Anopheles pseudopunctipennis* group, the author feels that two subspecies and one variety should be recognized at present; namely, *A. pseudopunctipennis pseudopunctipennis* Theo., *A. pseudopunctipennis franciscanus* (McCracken), and *A. pseudopunctipennis franciscanus* var. *boydi* (Vargas). Although this fine differentiation of the species into subspecies and varieties may help to clarify the situation, it is becoming unwieldy in our binomial system of nomenclature.

Anopheles punctipennis is capable of carrying malaria but its role in this disease is considered of minor importance. It is thought that this species may be the cause of some of the malaria in the Mother Lode region of the Sierra Nevada of California. The species, however, does not readily enter houses.

This paper is a good contribution to our knowledge of mosquitoes in their relation to malaria and should prove useful to mosquito control workers as well as to taxonomists.—Helen Sollers, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture, Washington, D. C.

TOXISCHE WIRKUNG VON NEOCID AUF LARVEN, PUPPEN UND IMAGINES VON *Anopheles* UND *Culex*. (Toxic effect of Neocid upon Larvae, pupae, and adults of *Anopheles* and *Culex*.) By A. Mandekos, 1944. Deut. Tropenmed. Ztschr. 48 (3/6): 84-88.

Neocid, "polychlorodiphenylethane 5 per cent powder 'adspers. cp. q. s.," (DDT) has been found by the Germans to be more effective against the larvae of *Anopheles superpictus* Grassi, than other known insecticides.

Mandekos' experiments with Neocid, carried out in 1943, were conducted along three lines: (1) as a dust, (2) as a water suspension, and (3) as a petroleum-water suspension.

It was found that the dust killed adults after 3½ hours but even after 15 minutes convulsive spasms were noticeable.

Scarcely more than 2 per cent of *Anopheles* and *Culex* larvae could be found alive after the application of the water suspension, in dilution of 3.5 per cent and at the rate of 0.035 g. of pure substance per square meter. This was applied in the open and in strong currents. When the suspension was sprayed in three cow stables in Saloniki all anophelines present were killed and the stables remained free of anophelines for one to five weeks.

Neocid-petroleum-water suspension is more effective than the water suspension alone when used in places with considerable current. The author recommends an increase in concentration Neocid to 4-5.5 per cent at the rate of 0.8 g. of Neocid per square meter for strong currents and for places where much organic material exsits, in which *Culex* particularly is found.

Mosquito eggs and pupae tested appear to be little if at all affected by the use of Neocid.

In the weak concentrations of Neocid used in these experiments, no toxic effect on man was observed.

Another insecticide, calcium arsenite, mixed with road dust in proportions of 3.5 per cent and tested against mosquito larvae in standing water, proved to be as satisfactory as paris green.

Note: From the facts presented, the procedures and results are difficult to interpret.—Helen Sollers, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture, Washington, D. C.

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